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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/588,283	07/23/2007	Masashi Kawasaki	S8810.0003/P003	5019

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EXAMINER	
HORNING, JOEL G	

ART UNIT	PAPER NUMBER
1792	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/588,283	KAWASAKI ET AL.	
	Examiner	Art Unit	
	JOEL G. HORNING	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *30 April 2009*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11,21 and 22* is/are pending in the application.

4a) Of the above claim(s) *10,11 and 22* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9 and 21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *12-7-06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Claims 10, 11 and 22 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected inventions, there being no allowable generic or linking claim. Applicant timely traversed the restriction (election) requirement in the reply filed on April 30th, 2009.

The traversal is on the ground(s) that there is no burden to examine the claims together. This is not found persuasive at least because the application was the national stage entry of a PCT application which does not require that a burden must be present in order to maintain a restriction requirement, only that the groups not share a special technical feature.

The requirement is still deemed proper and is therefore made FINAL.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. **Claims 1-7, and 9** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The terms "low temperature," in claims 1-4, 6, 7 and “high temperature” in claims 1, 2, 6 and 7 is a relative term which renders the claim indefinite. The terms "low temperature" and “high temperature” are not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in

the art would not be reasonably apprised of the scope of the invention. These temperatures might be relative to each other, or they might be "high" or "low" temperatures for some particular function. For example, 50 degrees Celsius is a “high temperature” for freezing water, but it is also a very “low temperature” for the purpose of boiling water. For the purposes of examination, it will be assumed that the temperatures are just relative to each other, so to meet the claim the “high temperature” must be higher than the “low temperature.” For the purposes of examination, it will be assumed that whatever temperature the examiner defines to be so will be the "high temperature" layer and a temperature that is relatively less than this will be a “low temperature.”

Claims 5 and 9 are rejected for being dependent upon rejected claims without correcting the indefiniteness.

3. **Claims 1-9 and 21** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The terms “highly doped,” in claims 1-4, 6 and 7, and “lowly doped," in claims 1, 2, 6 and 7, are relative terms which renders the claim indefinite. The terms “highly doped” and “lowly doped" are not defined by the claims, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. These doping levels might be suitable for a specific purpose, which would vary depending on the purpose (highly doped for an insulating layer could be considered very “lowly doped” for a layer

that is intended to be highly conducting) and these doping levels might be relative to each other. For the purposes of examination, it will be assumed that whatever doping level the examiner defines to be so will be the "highly doped" layer and a layer that is doped relatively less than this will be a “lowly doped” layer.

Claims 5, 8, 9 and 21 are rejected for being dependent upon rejected claims without correcting the indefiniteness.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. **Claims 1 and 3** are rejected under 35 U.S.C. 102(b) as being anticipated by Gwin (US 5786605).

   The independent **claim 1** is directed towards a method for manufacturing a thin film comprising:

   a. Doping a layer while growing it at a first low temperature so that it is “highly doped;” and
   b. Interrupting the growth of the thin film and annealing the thin film at a given second temperature higher than said first temperature.
   c. Growing a thin film at the second temperature that is “lowly doped.”

Gwin teaches a method of manufacturing a thin film by heating a chamber to a first low temperature, depositing a "highly doped" film at that first temperature. Deposition is stopped and the temperature is raised to an elevated temperature where dopants diffuse out of the doped layer and then is raised to a second temperature, which is an "oxidizing temperature," where the film is annealed (heat treated) and an oxide film is deposited on the substrate surface by oxidizing the depleted doped glass layer (col 2, lines 27-44). Since the doped glass layer is depleted and the oxygen further dilutes the dopant concentration in the previously "low temperature highly doped" layer, the oxide film is doped less than the first film, so it is a "high temperature lowly doped" layer **(claim 1)**.

Since **claim 3** has the limitations of claim 1, but does not require step "c" it is also met by Gwin.

5. **Claims 3 and 4** are rejected under 35 U.S.C. 102(b) as being anticipated by Ishizaki (WO02/089223, as literally translated in US 6939731)

The independent **claim 3** is directed towards a method for manufacturing a thin film comprising:

a. Doping a layer while growing it at a first low temperature so that it is "highly doped;" and
b. Interrupting the growth of the thin film and annealing the thin film at a given second temperature higher than said first temperature.

Ishizaki teaches a process of forming doped thin film by growing a thin film of in the presence of a dopant gas, interrupting the supply of the metal precursor,

so that film growth is stopped, annealing the film by heating it to a higher temperature (at least a hundred degrees Celsius higher), then cooling down the substrate to the growth temperature again, starting growth by flowing the precursor gases again and repeating the growth and anneal steps **(claims 3 and 4)** (col 18, lines 14-24,50-67).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining , obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. **Claim 5/1 and 5/3** are rejected under 35 U.S.C. 103(a) as being unpatentable over Gwin (US 5786605) in view of Koinuma et al (US 6617539).

Gwin teaches heating the substrates using resistive heating elements (col 4, lines 34-35), but it does not teach using a laser beam for this purpose.

However, Koinuma et al is also directed towards methods for forming thin films in reactors which require heating (abstract). It teaches that resistive heaters

(such as used by Gwin) have the potential to burn off when used in oxidative environments (col 1, lines 20-40), it instead teaches using a laser beam to heat the film deposition substrate. This is taught to be an effective method for heating the substrate in a very short period of time and is well suited for films that are to be deposited in oxidizing atmospheres (col 1, line 57 through col 2, line 2).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to replace the resistive heaters with a laser beam in order to heat the substrate since it was also known to be suitable for film deposition, would be more durable in the required oxidizing atmospheres and would be able to heat the substrate in a very short period of time.

7. **Claims 1, 2, 6, 7 and 8** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ishizaki, as evidenced by Tsukazaki.

The independent **claim 1** is directed towards a method for manufacturing a thin film that has the limitations of claim 3, but with an additional step after step b:

c. *Growing a thin film at the second temperature that is "lowly doped."*

8. Independent **claim 6** has the limitations of claim 1, but further requires that the film be a p-type zinc oxide film

Ishizaki teaches that the precursor gases can be abruptly cut off for the duration of the annealing step (which would avoid film growth during the annealing step) (figure 8A), but it also teaches that instead of a sharp transition at the start of the annealing step, during the annealing step, the precursor gases can be gradually decreased until they reach zero flow (growth interruption) then gradually increased

(figure 8D) (col 20, lines 13-17). The annealing temperature is maintained for between 5-15 seconds (col 19, line 65 through col 20, line 3). Thus, after the deposition is cut off (gas flow to zero), at the elevated annealing temperature, the gas flow is reinstated during the annealing step. Since the precursor gases are present at the elevated temperature, they will react to form a film at the elevated "higher temperature."

Ishizaki further teaches that their film is a zinc oxide thin film (in order to avoid confusion, the examiner notes that "a" can be zero, so p-type doped ZnO without any magnesium is taught, col 7, lines 56) that has particularly preferably been doped with nitrogen to render it p-type (col 12, lines 16-21). Additionally, the low temperature film growth takes place at a temperature between 300-400^{o}C (col 17, lines 16-24) and the high temperature annealing takes place at 700^{o}C (col 18, lines 63-65). Ishizaki does not teach that this film would be less doped than the low temperature growth film.

However, according to Tsukazaki et al, the absorption of nitrogen into ZnO is strongly temperature controlled, with higher temperatures resulting in much lower doping levels. As the temperature rises from 450^{o}C to 700^{o}C (a smaller temperature variation than taught by Ishizaki), the ability of the ZnO to incorporate nitrogen as a dopant drops 100 fold (page 43, left column). In other words, the concentration of nitrogen dopants in a film grown at higher temperatures will be lower than that of a film grown at lower temperatures.

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to grow nitrogen doped p-type ZnO films by using the taught process of Ishizaki, including growing a highly doped film at a first low temperature of 300-400°C, interrupting the film growth, annealing the film at 700°C and growing a second film for a time at the second higher temperature, which, from the teaching of Tsukazaki, it is readily apparent will be "lowly doped" compared with the film grown at the low temperature **(claims 1 and 6)**.

9. Regarding **claims 2 and 7**, as discussed previously, Ishizaki teaches repeating the process (col 18, lines 50-55).

10. **Claim 8** further require that the first temperature be about 300°C and the second temperature be about 800°C.

Ishizaki teaches a first temperature of about 300-400°C (col 17, lines 16-24) and the high temperature annealing takes place between 100 °C more than the first temperature to less than the melting temperature of the oxide (col 18, lines 63-65). Additionally, Ishizaki later teaches annealing zinc oxide films at 800°C (col 21, lines 6-7), so it is a temperature below the melting temperature of the oxide. MPEP 2144.05 states: "In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists."

11. **Claims 5, 9 and 21** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ishizaki in view of Koinuma et al (US 6617539).

Ishizaki teaches heating the substrates using a "heating source," such as an infrared lamp (col 24, lines 47-58), but it does not teach using a laser beam for this purpose.

However, Koinuma et al is also directed towards methods for forming thin films in reactors which require heating (abstract). It teaches using a laser beam to heat the film deposition substrate is an effective method for heating the substrate in a very short period of time and is well suited for films that are to be deposited in oxidizing atmospheres (col 1, line 57 through col 2, line 2).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to use a laser beam instead of the light from a lamp in order to heat the substrate since it was also known to be suitable for film deposition in oxidizing atmospheres and would be able to heat the substrate in a very short period of time and the substitution would lead to predictable results **(claims 5, 9 and 21)**.

Conclusion

12. No current claims are allowed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOEL G. HORNING whose telephone number is (571) 270-5357. The examiner can normally be reached on M-F 9-5pm with alternating Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael B. Cleveland can be reached on (571)272-1418. The fax phone

number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. G. H./
Examiner, Art Unit 1792

/Michael Cleveland/
Supervisory Patent Examiner, Art Unit 1792